

### REMARKS/ARGUMENTS

Favorable reconsideration of the present application is respectfully requested.

Claim 21 has been amended for clarity, consistent with the arguments that were presented in the last response. The scope of the claim has not been altered.

Claims 21, 23, 26 and 27 were rejected under 35 U.S.C. §103 as being obvious over Zywitski et al. This rejection is respectfully traversed.

As was explained in the last response, the claimed invention is directed to a method for producing an  $\alpha$  crystal structure-based alumina film by performing an initial stage of film formation under conditions best suited for the formation of  $\alpha$  crystal structure alumina, to thereby form an  $\alpha$  crystal structure alumina undercoat, and subsequently changing the film forming conditions to those suited for an advantageous feature as compared to the first step, e.g., greater productivity (Claim 22), lower temperature formation (Claim 23) or greater hardness (Claim 27). This two step  $\alpha$  crystal structure-based alumina film formation technique is based on the recognition that if an undercoat of  $\alpha$  crystal structure alumina is first laid down, the conditions can subsequently be changed without a substantial deterioration of the  $\alpha$  crystal alumina structure in the layer, evidently because the  $\alpha$  crystal alumina underlayer creates an  $\alpha$  crystal alumina structure nucleus upon which further  $\alpha$  crystal structure alumina is thereafter readily grown (paragraph bridging pages 13-14).

Zywitski et al does not disclose the two step process of the invention or provide evidence that it would be desirable. Zywitski et al simply describes that the formation of  $\alpha$  crystal structure alumina is temperature dependent. For example, p. 169 of Zywitski et al describes that the strongest influence on the alumina phase to be produced during CVD and PVD production is the substrate temperature, and that stable  $\alpha$  crystal phase layers require substrate temperatures above 1,000°C. Fig. 4 on p. 173 illustrates the relationship between substrate temperature and hardness. Moreover, the “Experimental Setup” described on page

170 indicates that the relationship shown in Fig. 4 was determined by applying the alumina layers on substrates having temperatures of 330, 480, 560, 690 and 760°C.

The Office Action recognizes that Zywitski et al does *not* teach the claimed method of first forming an undercoat of alumina film having an  $\alpha$  crystal structure under conditions suited for formation of  $\alpha$  crystal structure alumina, and a subsequent second step of continuing to form the film on the undercoat by changing the film forming conditions. However, it takes the position that while “Zywitski does not explicitly disclose the formation of the alumina structure in a two step process” on the same substrate in this experimental setup (p. 3), i.e., it does not disclose that the layers corresponding to the data points in Fig. 4 are formed one-over-the-other on the same substrate, it would have been obvious to do so for reasons of “energy savings, expected fluctuations from feedback controls or necessity to form a desired gradient coating” (p. 4).

However, it is respectfully submitted that it would make no sense for one skilled in the art to perform coating hardness testing to produce the hardness results shown in Fig. 4 by applying multiple coating layers one-over-the-other on the same substrate since this would produce meaningless results: the hardness of the coating layer being tested would then depend on the hardness of the layer(s) underneath. The measured hardness of a coating layer applied onto a low hardness underlayer at a certain substrate temperature would be affected by the hardness of the underlayer and would be different from that of a layer applied directly on the substrate at that substrate temperature. Therefore the test results of Fig. 4 would be meaningless in the case of multiple layers applied on the same substrate unless the reader was provided with a way to account for the effect of the underlayer on the measured hardness.

In any case, the claimed two step process would not have been obvious simply because the experimental setup of Zywitski et al *could have* been used to apply multiple coating layers one-over-the-other on the same substrate because the claimed invention

provides unpredictable results. *KSR International Company v. Teleflex Incorporated*, 127 S. Ct. 1727 (2007). That is, the invention is based upon the recognition of a synergy whereby an  $\alpha$  crystal alumina structure can be assured, even under conditions suitable for rapid crystal growth, once a nucleus of an  $\alpha$  crystal structure underlayer has first been laid down. This would not have been predictable from the simple disclosure in the prior art that the formation of  $\alpha$  crystal structure alumina is temperature dependent, and so the subject matter of Claims 21, 23, 26 and 27 would not have been obvious from Zywitski et al.

Dependent Claims 22 and 25 further recite that the film forming conditions in the second step are changed to higher rate film forming conditions. Claims 28-29 further recite that the second step is performed at a higher negative bias voltage. Claims 22, 25, 28 and 29 were rejected under 35 U.S.C. §103 as being obvious over Zywitski et al in view of Sproul et al, particularly in reliance on Fig. 15 of Sproul et al. It is respectfully submitted that these claims define over this prior art.

Applicants had previously argued that Sproul et al does not disclose changes of operating conditions during film deposition resulting in an increasing deposition rate. Instead, the graph of Figure 15 in Sproul et al simply discloses a plurality of data points indicating a relationship between the substrate current density and deposition rate whereby the deposition rate increases with increased current density. In response, the outstanding Office Action specifically relied on the description at lines 4-6 of col. 13 that Fig. 15 indicates that the “increased substrate bias potential was then varied as indicated.”

However, this description in Sproul et al is entirely consistent with Applicants’ argument that Fig. 15 merely shows data points for the deposition rates in three separate experiments using three separate substrates. The statement that the “increased substrate bias potential was then varied as indicated” simply means that the substrate bias potential was different in the three experiments. The reason that this must be so is similar to the reason that

one skilled in the art would not have applied multiple coating layers one-over-the-other in Zywitski et al: it would make no sense for the data points of the graph in Fig. 15 to represent results performed on a single substrate because such results would then be meaningless.

Since Fig. 15 of Sproul et al is designed to show how the deposition rate changes for different substrate current densities, a meaningful result requires that all other test parameters remain identical for each data point, including the material onto which the layer is to be applied.

Under the multi-layer interpretation of the Office Action, on the other hand, the deposition rate at the first data point ( $5.7 \text{ mA/cm}^2$ ) would be determined for a layer applied on a stainless steel coated silicon substrate, but the remaining data points would be determined for layers applied on the previously applied layers. The data points would therefore be based on inconsistent test conditions and so would be meaningless. Therefore, one skilled in the art would recognize that Sproul et al does not provide its purported teaching.

Claim 24 further recites that the film formation in the first step is carried out in a poisoning mode discharge condition and the discharge condition of the second step is changed to a transition mode or a metal mode. Claim 24 was rejected under 35 U.S.C. §103 as being obvious over Zywitski et al in view of Fu. Applicants had previously argued that Fu is not relevant because it is concerned with the production of a titanium nitride (TiN), whereby the TiN film produced in a poisoning mode may sometimes be desirable because it has low stress (column 11, lines 43-45; column 12, lines 14-15). According to Fu, if one wishes to operate in the generally preferred metallic mode of TiN production, it is desirable not to exceed the intermediate ramp up pressures 200 in Figure 17. But if the poison mode is preferred, one first reaches the higher pressure 206 followed by decreasing to the ramp down intermediate pressure 202. In either case, the teaching is only applicable to TiN production.

In reply, the outstanding Office Action noted that the background portion of Fu states that sputtering can also be used to form an alumina layer (col. 1, lines 30-35). **Nonetheless,**

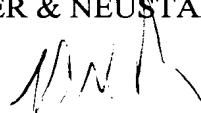
**Fig. 17 and the description beginning at line 35 of col. 11 deal exclusively with reactive sputtering using nitrogen gas,** and so the aforementioned argument is believed to remain valid. The evident desirability of a poison mode in Fu has no relevance to the desirability of a poison mode for alumina, since there is no evidence that an alumina layer produced in the poisoning mode would have characteristics which are advantageous in the manner of the TiN layer produced in the poisoning mode of Fu.

Applicants had also argued that Fu does not disclose a method of initiating the deposition in a poisoning mode and then moving into metallic mode, but instead discloses that an initial metallic mode may be followed by the poison mode (column 12, lines 13-16). In reply, the outstanding Office Action pointed to the description at lines 16-20 of col. 12 that poisoning can alternatively be achieved by providing immediate gas flow with gradual application of a biasing voltage. However, this teaching is only for a method of achieving a poisoning mode (which is described as being desirable for low stress in TiN). There is no teaching that it should be followed by a metal mode, i.e., no teaching of a two step process. [It should be noted that this alternative description cannot properly be combined with the earlier description of an initial metallic mode followed by the poison mode (column 12, lines 13-16) since the two steps in that earlier description were necessary to reach the desired poisoning mode, but are not necessary to reach the poisoning mode in the alternative description now being relied on]. Accordingly, the claims are believed to define over any combination of the prior art including Fu.

Applicants therefore believe that the present application is in a condition for allowance and respectfully solicit an early notice of allowability.

Respectfully submitted,

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